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ABSTRACT

This publication is divided into five parts. The first part provides the aims and objectives of the booklet. These include assisting high school students to discover the career opportunities in marine-related occupations and to prepare for some of the jobs listed in the booklet. Section two contains resource information: publications, organizations, and state resources. In section three, examples of scientific jobs available are described. These are divided into biological, chemical, geological, physical, environmental, and general. Professional Careers are listed in section four. These include careers requiring a college degree: Government Related, Environmental Affairs, Armed Services and Related Organizations, Consultation and Education, Engineering, Business and Industry, and General. Technical careers are treated in section five. Listed are Boat Building and Repair, Sales, Marine Construction and Maintenance, Commercial Fishing, Marine Recreation, and Maritime Operations. (MA)

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Marine-Related Occupations: A Primer for High School Students

Reprinted from Marine Memorandum Number 41 edited by Prentice K. Stout and Sara S. Callaghan, Marine Advisory Service, University of Rhode Island, April 1976.

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I. Aims and Objectives

1. To assist high school students to better understand the broad scope of job opportunities in marine-related occupations by indexing examples of job descriptions from scientific, professional, and technical fields.

2. To assist college-oriented high school students in choosing high school and college courses that will prepare them for some of the jobs described in this memorandum. A number of colleges and universities list undergraduate courses in marine-oriented subjects (see Resource Information).

No effort is made to specify undergraduate courses that would lead to graduate school placement in oceanography. Individual graduate schools' requirements should be obtained from the schools (see Resource Information).

Some of the job opportunities do not require college degrees but might require special training. Students should request information on this training from their guidance office or career resource center.

Some states are instituting marine vocational/technical programs at the high school level. Contact the Department of Education in your state for a list of these schools.

Training for certain jobs may best be obtained by "on-the-job" training. Job availability will determine these careers.

II. Resource Information

PUBLICATIONS

University Curricula in Marine Science and Related Fields (no charge). Director, National Sea Grant Program, NOAA, Department of Commerce, 3300 Whitehaven Street, NW, Washington, DC 20235.

So You Want To Be A Marine Scientist. Miami Seaquarium, Rickenbacker Causeway, Miami, FL 33149.

Training and Careers in Marine Science. International Oceanographic Foundation, 10 Rickenbacker Causeway, Virginia Key, Miami, FL 33149. (50 cents; free to IOF members.)

Opportunities in Oceanography ($1.25). Smithsonian Press, Smithsonian Institution, Washington, DC 20560.

Oceanography Information Sources. Printing and Publishing Office. National Academy of Sciences, 2101 Constitution Avenue NW, Washington, DC 20418.

The Oceans and You ($3). Marine Technology Society, 1730 M Street NW, Suite 412, Washington, DC 20036.

Marine Occupations in the Texas Coastal Zone. College of Education, Texas A&M University, College Station, TX 77843.

Occupational Outlook Handbook. U.S. Department of Labor, Bureau of Labor Statistics, Washington, DC 20212.

The Boating Business. Nat'l Association of Engine & Boat Manufacturers, Greenwich, Conn., 1970.

Marine Manpower: An Initial Assessment. Edward F. Mackin and Roger D. Anderson, MTS Journal 10(4), May 1976.

Sea Careers. D.X. Fenton, J.P. Lippincott Company, New York, 1970.

New York Port Handbook, Maritime Association of Port of New York, 80 Broad St., N.Y., N.Y., 10004.

ORGANIZATIONS

Environmental Protection Agency. 401 M Street SW, Washington, DC 20024.

Marine and Industrial Associates, Inc. 4545 Connecticut Avenue NW, Washington, DC 20008.

National Association of Engine and Boat Manufacturers. P. O. Box 5555, Grand Central Station, New York, NY 10017.

American Fisheries Society. 1319 18th Street NW, Washington, DC 20036.

National Oceanographic Association. 2000 L Street NW, Washington, DC 20036.

American Institute of Biological Sciences. 3900 Wisconsin Avenue, Washington, DC 20202.

Department of State. 220 C Street NW, Washington, DC 20036.

Project Seal. Marion, MA 02738. (Offers educational apprenticeships in sea-related professions.)

U.S. Merchant Marine Academy, Kings Point, New York, 11024.

Maritime Association of Port of New York, 80 Broad St. N.Y., N.Y., 10004.

WHERE TO WRITE IN YOUR STATE

Alaska
Marine Advisory Service
3211 Providence Avenue
Anchorage, AK 99504

Alabama
Resource Use Division
Cooperative Extension Service
Auburn University;
Auburn, AL 36830

California
Marine Advisory Program
University of California
Davis, CA 95616

Connecticut
Marine Advisory Service
University of Connecticut
322 N. Main Street
Wallingford, CT 06492

Delaware
Marine Advisory Service
College of Marine Studies
University of Delaware
Newark, DE 19711

Florida
Marine Advisory Program
3002 McCarty Hall
University of Florida
Gainesville, FL 32611

Georgia
Sea Grant Program
University of Georgia
110 Riverbend Road
Athens, GA 30602

New Jersey
Marine Science Center
Rutgers University
New Brunswick, NJ 08903

New Hampshire
UNH Sea Grant Marine Advisory
Service, Kingsbury Hall
University of New Hampshire
Durham, NH 03824

Louisiana
Sea Grant Program
Coastal Studies Building
Louisiana State University
Baton Rouge, LA 70803

Maine
Cooperative Extension Service
Univ. of ME Marine Lab.
Walpole, ME 04573

Maryland
Cooperative Extension Service
1224 Symons Hall
University of Maryland
College Park, MD 20742

Massachusetts
MIT Sea Grant Program
MIT, Room 1-211
77 Massachusetts Avenue
Cambridge, MA 02139

Michigan
Coordinator, Advisory Service
Michigan Sea Grant
2200 Bonisteel Boulevard
University of Michigan
Ann Arbor, MI 48105

Minnesota
Marine Advisory Service
325 Administration Building
University of Minnesota
Duluth, MN 55812

Mississippi
Sea Grant Advisory Service
Box 4557
Biloxi, MS 39531

Pennsylvania
Urban Forest Wildlife Specialist
11 Ferguson Building
Pennsylvania State University
University Park, PA 16802

South Carolina
Marine Resources Center
P. O. Box 12559
Charleston, SC 29412

New York
NY Sea Grant Advisory Service
Fernow Hall
Cornell University
Ithaca, NY 14853

North Carolina
Extension & Public Service
NC State University
133, 1911 Building
Raleigh, NC 27607

Ohio
Extension Wildlife Specialist
232B Howlett Hall
2001 Fyffe Center
Ohio State University
Columbus, OH 43210

Oregon
Marine Advisory Program
OSU Marine Science Center
Newport, OR 97365

Rhode Island
Marine Advisory Service
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882

Texas
Education & Advisory Services
Center for Marine Resources
Texas A&M University
College Station, TX 77843

Virginia
Department of Advisory Services
Virginia Institute of Marine Science
Gloucester Point, VA 23062

Washington
Washington Sea Grant Marine Advisory Program
University of Washington-HG30
Seattle, WA 98195

Wisconsin
Advisory Services
420 Lowell Hall
610 Langdon Street
Madison, WI 53706

III. Scientific Careers

Examples of the types of scientific jobs available are described in the categories below. At this level the job market is small, and applicants must have a college or advanced degree, a broad interdisciplinary background in science and mathematics, and further specialization in one major area of study.

BIOLOGICAL

Biological Oceanographers (Aquatic Biologists) study marine, plant, and animal life and seek knowledge of the environmental factors affecting them. Areas of study include the effects of pollution, extraction methods of food and drugs, and maintenance of natural balance. Specialities are marine mammalogy, ichthyology, bacteriology, algology, parisitology, and planktology.

Fisheries Scientists study biological, chemical, and physical factors that will, when coupled with fishing demands, affect the population dynamics of finfish and shellfish. They suggest legal actions necessary to conserve overfished populations.

Marine Bacteriologists identify diseases of marine life and seek ways to control them. They develop ecologically sound methods of detecting and destroying harmful bacteria in the marine environment.

Aquaculturists research, design, and implement methods used in the commercial production of marine plants and animals.

Biochemists study the chemical composition of living organisms within the oceans. They identify and analyze the chemical processes related to biological functions.

Physiologists probe into the structure and function of plant and animal organs, tissues, and cells. They study the effects of the life processes of marine plants and animals on the marine environment.

Fisheries Technicians assist fisheries scientists. They should be familiar with population and environmental survey techniques, tagging procedures, collecting methods, organ and tissue removal, and stomach analysis for food and feeding habits. Fisheries technicians help design and construct fishing gear and fishways and aid in fish farming and hatchery production.

Limnological Technicians carry out work of an oceanographic nature on fresh water lakes. They take water samples, carry out field and laboratory analyses, measure physical parameters, and care for and maintain the sampling and measuring equipment used in hydrography. Limnological technicians perform routine lab tasks, such as weighing and mixing solutions, and perform quantitative studies on water and the life forms in it.

CHEMICAL

Chemical Oceanographers study the chemical composition of seawater, the relationship between organic and inorganic compounds found in the

sea, presence of dissolved nutrients, and the sources of dissolved and organic matter. They perform research on the chemical composition of sediments, and the desalinization and extraction of rare seawater components.

Chemical Technicians assist chemical oceanographers in conducting analytical laboratory procedures such as measuring salinity and dissolved oxygen, analyzing and tabulating data, and assembly and use of scientific apparatus.

GEOLOGICAL

Geological Oceanographers study topographic features, rocks, and sediments characteristic of the ocean floor. They determine development and changes of the oceans through examination of fossils, rocks, and minerals; they assist in the location of petroleum and mineral deposits beneath the sea and aid in the engineering of tunnels, bridges, and dams.

Geological Technicians aid geological oceanographers in analyses of components of the earth's crust under the oceans and in drawing maps and charts depicting locations and descriptions of geological formations.

PHYSICAL

Physical Oceanographers study physical properties of the ocean environment such as temperature, density of seawater, ability of seawater to transmit light and sound, characteristics of currents and tides, and relationships between the atmosphere and the sea.

Marine Physicists observe and analyze various forms of energy, the structure of matter, and the relationship between matter and energy as they relate to processes occurring in the oceans.

Geographers study special characteristics of the earth's terrain, sediments, vegetation, and climate in relation to the oceans. They analyze maps, aerial photographs, and observational data collected in the field.

Cartographers design and construct maps of physical oceanic features. They also compile data pertaining to those features.

Meteorologists study atmospheric conditions and related data to obtain information for short-term and long-range weather forecasting. They conduct research on long-range forecasting, radio wave propagation, and severe weather phenomena such as typhoons and hurricanes.

Hydrographic Survey Technicians assume responsibility for operating standard surveying instruments, including bottom grabs, sextants, measuring instruments, depth recorders, wire drags, and navigational equipment. They read charts and assist cartographers in the field. These technicians assist with data acquisition, processing, and analysis, as well as the interpretation of the original data. Work ranges from surveying and engineering in tidal and coastal areas to geomagnetic and hydrospace seismological observations.

Marine Engineering Technicians aid in the research and development necessary to coastal and amphibious engineering. The work deals with

hydro-mechanics, waterfront structures, and amphibious equipment. They assist various hydraulic, structural, and general research engineers to set up experiments, to conduct experiments, and in theoretical investigations including data reductions, machine computations, and marine engine operations.

ENVIRONMENTAL

Marine Ecologists study the mutual relationship among organisms and their environment. They examine effects of environmental influences such as rainfall, temperature, season, and state of tide on these organisms.

Water Pollution Technicians work with scientists to determine the extent of pollution in bays, estuaries, and the oceans; they are involved in research concerning control and abatement of industrial and other pollutants. These technicians participate in surveying questionable geographic areas, as well as in the design of sampling systems. They assist life scientists in conducting ecological studies in waters suspected or known to be polluted.

GENERAL

Systems Analysts and Computer Programmers analyze scientific processes and problems associated with the collection, organization, and reporting of data, and convert the data to a form suitable for automatic data processing equipment.

Applied Statisticians survey, collect, organize, interpret, summarize, and analyze numerical data related to sampling. Through the use of statistical tools, they interpret the data gathered in marine-related studies.

Oceanographic Technicians assist oceanographers in a variety of chemical and physical tests and analyses, such as tide and current studies, water analysis for dissolved gases and minerals, and wave studies. They maintain cleanliness and order in the laboratory ashore and afloat, keep up the inventory in the laboratory stock, calibrate and operate measuring and surveying instruments used in oceanographic data acquisition, keep records, plot graphs and profiles, and reduce processed oceanographic station data to a standard format.

Dock Support Technicians assist in the deck support party aboard an oceanographic vessel. They should have a familiarity with a broad range of physical, chemical, meteorological, biological, and geological oceanographic sampling and measuring instruments. These technicians are required to rig these instruments and sampling devices for over-the-side use, to operate all types of oceanographic winches and booms during actual operations, and to stow and repair many of these tools when they are not being used. They crate and label all equipment and samples for shipment to shore installations.

Applied Research Technicians design new equipment using basic marine science concepts.

Oceanographic Instrumentation Technicians determine instrument accuracy, modify equipment, and design new auxiliary apparatus.

IV. Professional Careers

Although categorizing these listings under the general heading "professional" is difficult, certain generalizations can be made. Personnel within this category are highly trained individuals usually possessing at least an undergraduate college degree. The job opportunities at this level are more widespread than at the scientific level. A broad range of high school studies and an interdisciplinary college program should be undertaken before specialization is sought. Assistants to professionals require training in some specific aspect of technology, business, or science.

GOVERNMENT RELATED (LOCAL, STATE, FEDERAL)

Coastal Zone Management personnel identify natural areas encompassed by the coastal zone and analyze the effects changes in the zone have on interdependent units in areas designated as natural ecosystems. They also develop management criteria for carrying out land and water use guidelines in these coastal areas.

Salt Marsh Management personnel develop systems for rating the quality of existing salt marshes to set preservation priorities, and work with local and state officials to determine the possibilities for creating new artificial marshes from environmental wastes.

Barrier Beach Management personnel identify areas to be regarded as barrier beaches, develop systems for their preservation, and determine policies for their use.

ENVIRONMENTAL AFFAIRS

Environmental Health Services Sanitarians plan and conduct programs related to sanitation. They promote the maintenance of health standards, and monitor the use of oceans for waste disposal. Sanitarians also enforce laws regarding handling, dispensing, and consumption of food from coastal waters.

Environmental Health Services Toxicologists detect and analyze poisonous substances in the oceans.

Environmental Planners attempt to prevent and alleviate environmental problems through the effective use of existing land, taking into consideration appearance as well as land use. They estimate the long-range needs of the coastal zone for a wide variety of problems and services.

Environmental Regulation personnel inspect all phases of coastal zones, and through governmental agencies (e.g., EPA) set guidelines for the implementation of a broad range of regulations.

ARMED SERVICES AND RELATED ORGANIZATIONS

U.S. Coast Guard personnel are responsible for the protection of the nation's coastline. They regulate foreign and domestic fishing within U.S. coastal waters, recreational boating, and navigational markers. All tours of duty are within areas under U.S. jurisdiction.

U.S. Navy personnel perform a broad range of duties that involve the defense of the U.S. Extensive research and development in ocean-related disciplines are carried out.

Army Corps of Engineers personnel are responsible for construction and maintenance of dams, navigational waterways, rivers, harbors, and shoreline structures.

Merchant Marine: The captain has responsibility for the operation of ocean-going vessels carrying domestic and foreign commerce. He is responsible for maintaining order and the safety of the crew, passengers, cargo, and vessel. The captain functions as agent for ship owners by conferring with customs officials and may also act as paymaster for the ship. Other officers, "mates," consist of professional and supervisory personnel working on the deck, in the engine room, and in charge of radio equipment and other duties.

National Oceanic and Atmospheric Administration (NOAA) personnel are responsible for a wide range of duties that include weather services, satellite systems, marine fisheries, charting and navigation, coastal zone management, environmental research, data gathering, and university applied research programs.

CONSULTATION AND EDUCATION

Coastal Resources personnel compile inventories of coastal resources upon which are based technical recommendations concerning coastal zone planning and management.

Education personnel prepare and disseminate a broad range of marine education materials useful to students, teachers, and the general public. They may also instruct in environmental and marine-related problems, and in the role of citizens in solving these problems. Education personnel fulfill the essential needs to create an environmental awareness and to provide the insight necessary for long-range decision making on matters of global conservation. They may teach any of the following audiences: elementary and secondary, college and university, vocational, technical, and public awareness groups.

Fisheries personnel work as field specialists with experience and training in the operation of fishing vessels and gear. They consult with commercial fishermen on the application and introduction of new fishing techniques.

Seafood Processors transfer practical scientific and technological food processing data and procedures to the marine food processing industry.

Recreation personnel provide information to coastal planners, boating businessmen, marine insurance specialists, environmentalists, and marine researchers regarding coastal planning for marine recreation (swimming, boating, sport fishing, and beachcombing).

Marine Insurance personnel research and write insurance policies to cover both commerical and private fishing vessels, cargo transports, recreational boats, and marinas.

Maritime Lawyers are responsible for implementation and interpretation of international marine law and the laws governing coastal zone managment. An Admiralty lawyer specializes in legal matters that relate to inland waters and the high seas.

ENGINEERING

Mechanical Engineers work with the engineering staff on prototype design, development and tooling. They design and test the structural integrity of manufactured parts. They work on marine engines (gas and diesel), generators, steering controls, castings, pumps, hydraulics systems, plumbing, hardware, and extrusions.

Coastal and Ocean Engineers study beach erosion, littoral drift, and the effects of tides, currents, and weather on the stability of coastal features. Such data is valuable in determining the placement of dikes, pilings, drill rigs, groins, and breakwaters. Physical forces that affect harbor, inlet, and waterway maintenance are also studied. Research on and development of materials to be used in the salt water environment are also performed.

Oceanographic Equipment Engineers design and build systems and instruments for oceanographic research and operation. Other tasks include laying cables, supervising underwater construction, locating sunken ships and handling the recovery of their cargoes.

Environmental Engineers specialize in applying engineering principles and practices to oceanic environmental problems with a view to improving and protecting living conditions. They seek to limit the degradation of natural resources, and to wisely manage the environment.

Project Engineers develop specifications for lighting, steering, controls, and other sub-assemblies. They develop the structure and construction of new boats, resolving technical problems as they arise. The project engineer supervises all phases of project development, and develops schedules, cost predictions, and cost-and-schedule analyses.

Fisheries Engineers operate and design a wide range of gear including pumps and engines, fishing tackle, and dock-side facilities.

Electronics Engineers design highly sensitive electronic instruments used in all phases of oceanographic research. The instruments include sonar and radar equipment, ship-to-shore communication equipment, and all types of biological, physical, and chemical monitoring systems.

Plastics Engineers study the properties and structure of materials used in the plastics/fiberglass industry. They study vacuum forming, dye casting, extrusion, and other processes.

BUSINESS AND INDUSTRY

Industrial Marine Economists study and analyze the economic factors involved in marine-related products distribution and use of goods and services. Techniques of financing and marketing are examined, and improvements are suggested. Organizational structures of marine-related business concerns are outlined; governmental regulations and requirements are studied.

Market Research Analysts monitor and analyze the marine products market in an attempt to answer questions about consumers, dealers, and competitors. The products include seafood, boats and accessories, and fishing equipment. The analysts work in research involving social and economic trends, as well as human motives and patterns of human behavior.

Museum and Aquarium Administrators manage the business aspects of and oversee the construction of displays in museums and aquaria.

Energy and Mineral Explorers are engineers, geologists, and technicians engaged in exploration for and research in natural gas, oil, and minerals located in offshore waters.

GENERAL

Underwater Technicians work as trained, qualified divers, capable of working with commercial diving apparatus, mixed gas supplies, underwater tools, and safety equipment. They work in oil fields, rigging pipelines and wellheads. They test and operate underwater communications systems, photographic equipment, and underwater closed circuit television.

Technical Writers produce manuals and technical publications dealing with all aspects of marine work. They assist in the preparation and layout of publications used for recording research and technical work.

Statisticians collect, analyze, and interpret marine data. They summarize findings in tables, charts, and written reports for use by professionals in the marine industry.

V. Technical Careers

This is the most broadly based category included in this memorandum. Technical personnel transform the ideas of the scientists and professionals into goods and services. Although often not as sought after or desirable as the professional and scientific positions, technical personnel play an important role. In this major category, there is a vital need for technically and vocationally trained people. As more schools begin undertaking marine-related programs, their graduates will have a better chance of competing in the job market.

BOAT BUILDING AND REPAIR

These personnel are involved in the construction and repair of sail and power boats for both commercial and recreational use:

Electricians
Mechanics (diesel and gas)
Electronics (repair, sonar, radar, etc.)
Welders
Painters
Carpenters
Fiberglass technicians
Sail and rigging
Sheet metal workers
Tool and die makers

SALES

These salespeople work in the distribution and sale of marine products:

Boats (power and sail)
Electronics equipment
Fishing equipment
Seafood products
Marine engines
Boating accessories
Marine insurance
Real estate

MARINE CONSTRUCTION AND MAINTENANCE

Workers in the field of marine construction and maintenance are involved in a broad range of construction applications:

Mining and petroleum (offshore equipment)
Piers, breakwaters, harbors, channels
Power plant and energy installations

COMMERCIAL FISHING

Examples of dock and vessel personnel involved with the commercial fishing and shellfishing industry are listed below:

Fishing captains
Deckhands
Cooks
Engineers
Fish handlers and processors

MARINE RECREATION

Marinas — in addition to working with boat renting, repair, and sales, marina personnel also are involved in marina management and operation activities such as dock and slip maintenance and rental, moorings, boat hauling and storage, and gasoline sales.

Charter or party boats
Tour boats
Shore/seaside restaurants
Yacht or sailing clubs
Water safety programs

MARITIME OPERATIONS

Enlisted personnel
Port, harbor and inland operations personnel
- tugboat operators & crews
- ferryboat operators
- barge & salvage operations
- harbor pilots
- radio operators
- harbor police & firemen

Commercial Shipping
- longshoremen
- bursars
- warehousemen
- cargo & tanker crews